5.4.3 SEVERE STORM

This section provides a profile and vulnerability assessment for the severe storm hazard.

HAZARD PROFILE

This section provides profile information including: description, location and extent, previous occurrences and losses and the probability of future occurrences.

Description

The severe storm hazard includes hail, wind, lightning, thunderstorms, and tornados. Other severe storms include hurricanes/tropical cyclones and Nor'easters, which are discussed further in this section (Section 5.4). Due to the increased susceptibility of these hazards upon SC, they were considered major hazards that should be discussed individually within this HMP; therefore, this section will not include information regarding historical hurricanes/tropical cyclones and Nor'easters. A description of hazards categorized as Severe Storms are provided below.

Hail: Showery precipitation in the form of irregular pellets or balls of ice more than 5 millimeters (mm) in diameter, falling from a cumulonimbus cloud (NWS, 2005).

Lightning: An electrical discharge that results from the buildup of positive and negative charges within a thunderstorm (NWS, 2006).

Thunderstorm: A combination of moisture, rapidly rising warm air and a force capable of lifting air such as a warm and cold front, a sea breeze, or a mountain. All thunderstorms contain lightning and can produce hail (NWS, 2005). A thunderstorm produces wind gusts less than 50 knots (25 meter/seconds) and hail, if any, of less than 3/4-inch diameter (20 mm) at the surface. Wind or hail damage may be used to infer the occurrence/existence of a severe thunderstorm.

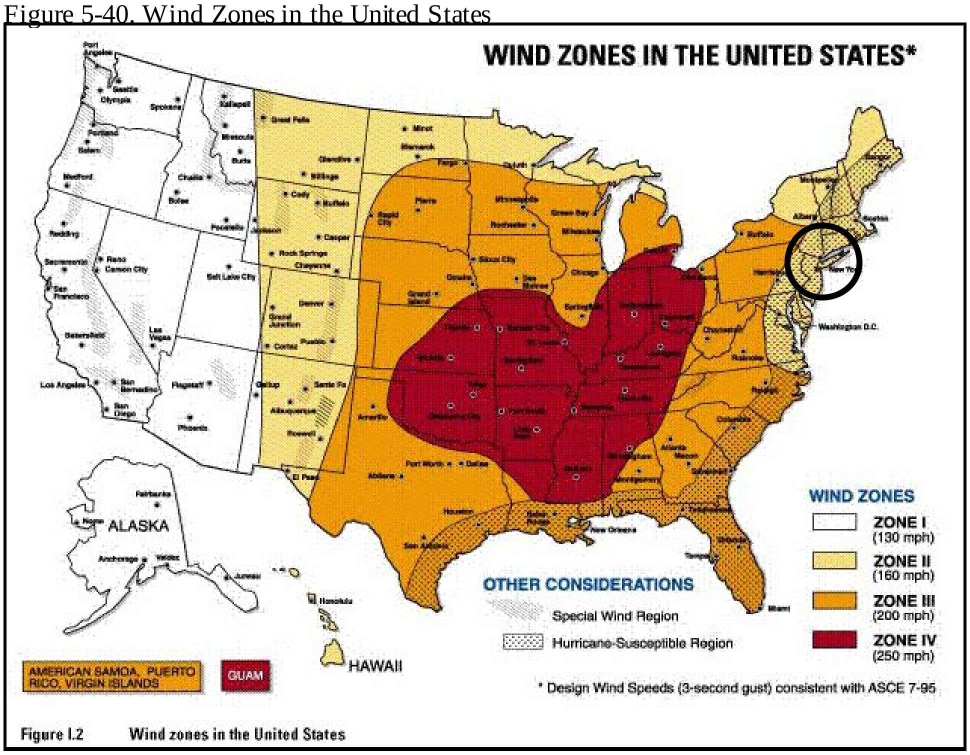
Tornado: A violent windstorm characterized by a twisting, funnel-shaped cloud. It is spawned by a thunderstorm (or sometimes as a result of a hurricane) and produced when cool air overrides a layer of warm air, forcing the warm air to rise rapidly. The damage from a tornado is a result of the high wind velocity and wind-blown debris. Tornado season is generally March through August, although tornados can occur at any time of year (FEMA, 2004).

Windstorm: Wind is air moving from high to low pressure. It is a rough horizontal movement of air (as opposed to an air current) caused by uneven heating of the Earth's surface. It occurs at all scales, from local breezes generated by heating of land surfaces and lasting tens of minutes to global winds resulting from solar heating of the Earth. The two major influences on atmospheric circulation are the differential heating between the equator and the poles, and the rotation of the planet. Windstorm events are associated with cyclonic storms (e.g., hurricanes), thunderstorms, and tornados (FEMA, 1997).

Location and Extent

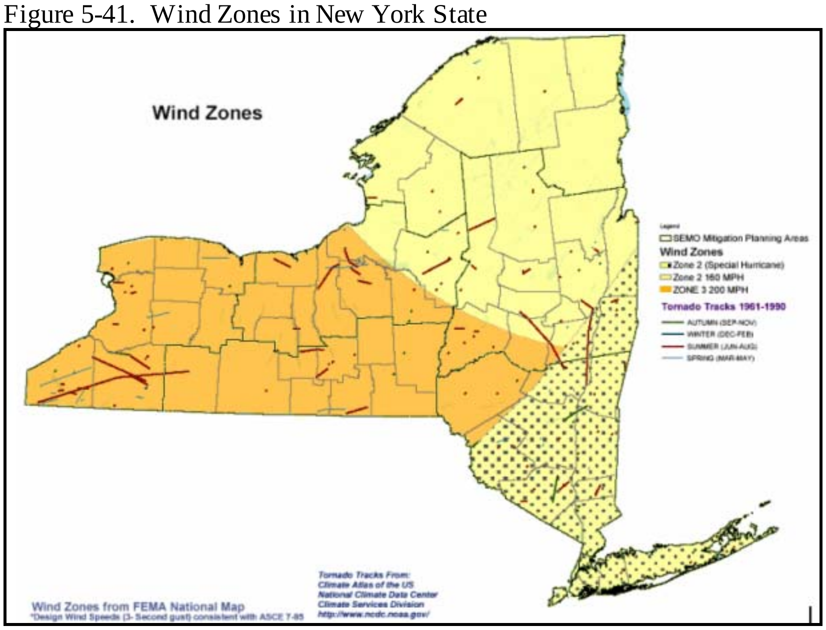
Severe storms may affect the entire mitigation study area. The extent (that is, magnitude or severity) of a severe storm is largely dependent upon sustained wind speed. Figures 5-40 and 5-41 show designated wind zones that impact the United States and NYS, respectively. SC is located in Wind Zone II with speeds up to 160 miles per hour (mph) and is also located in the Hurricane-Susceptibility Region which extends along the southern and eastern coastlines. The NYS HMP indicates that SC is the No. 1 County in NYS most threatened by extreme wind and vulnerable to extreme wind losses. Hurricanes are discussed later in this section (Section 5.4).

Figure 5-40. Wind Zones in the United States



Source: FEMA

Figure 5-41. Wind Zones in New York State



Source: New York State Hazard Mitigation Plan, 2005.

The magnitude or severity of a tornado was originally categorized using the Fujita Scale or Pearson Fujita Scale (introduced in 1971). Other scales have been developed to measure wind and tornado intensity including the Beaufort Wind Scales (B-Scales) and Britain's Tornado Storm and Research Organization

(TORRO) Scale (T-Scale); however generally they are not used to identify the severity or intensity of a tornado or wind event in the United States. The Fujita Scale categorizes tornadoes from F0 (Gale) to F5 (Inconceivable) based on wind speed (Table 5-18) (NOAA, Date Unknown). It is used to rate the intensity of a tornado by examining the damage caused by the tornado after it has passed over a man-made structure.

Table 5-18. Fujita Damage Scale

Scale	Wind Estimate (MPH)	Typical Damage
F0	< 73	Light damage. Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	73-112	Moderate damage. Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	113-157	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158-206	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	207-260	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
F5	261-318	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yards); trees debarked; incredible phenomena will occur.

Source: (NOAA, Date Unknown)

However, this scale recently become obsolete, due to many weaknesses in the system that have resulted is misuse and/or misunderstanding of the scale. It was replaced on February 1, 2007, by the Enhanced Fujita Scale, or EF Scale (Table 5-19). This new scale continues to rate the strength of tornadoes in the United States based on the damage caused. The scale has the same basic design as the original Fujita Scale (six categories from 0 to 5 representing increasing degrees of damage). It was revised to reflect better examinations of tornado damage surveys, to align wind speeds more closely with associated storm damage. As with the Fujita Scale, though each damage level is associated with a wind speed, the Enhanced Fujita Scale is a damage scale and the wind speeds associated with the damage listed remain unverified and little more than educated guesses. The EF Scale improved on the old scale on many counts—it accounts for different degrees of damage that occur with different types of structures based on how they are designed, both man-made and natural. It also provides much better estimates for wind speeds and sets no upper limit on the wind speeds for the strongest level, EF5 (NOAA-SPC, 2007).

Table 5-19. Enhanced Fujita Damage Scale

F-Scale Number	Intensity Phrase	Wind Speed (mph)	Type of Damage Done
EF0	Light tornado	65–85	Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.
EF1	Moderate tornado	86-110	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	Significant tornado	111-135	Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	Severe tornado	136-165	Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	Devastating tornado	166-200	Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
EF5	Incredible tornado	200>	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (109 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.

Source: (Wikipedia, 2007)

When using the EF-Scale to determine the tornado's EF-rating, one begins with a set of 28 Damage Indicators (Table 5-20). Each one of these indicators has a description of the typical construction for that category of indicator. The next step is to find the Degree of Damage (DOD). The DOD in each category is given, along with the expected estimate of wind speed, a lower bound of wind speed and an upper bound of wind speed.

Table 5-20. Enhanced F-Scale Damage Indicators

Number	Damage Indicator	Abbreviation	Number	Damage Indicator	Abbreviation
1	Small barns, farm outbuildings	SBO	15	School - 1-story elementary (interior or exterior halls)	ES
2	One- or two-family residences	FR12	16	School - jr. or sr. high school	JHSH
3	Single-wide mobile home (MHSW)	MHSW	17	Low-rise (1-4 story) bldg.	LRB
4	Double-wide mobile home	MHDW	18	Mid-rise (5-20 story) bldg.	MRB

Number	Damage Indicator	Abbreviation	Number	Damage Indicator	Abbreviation
5	Apt, condo, townhouse (3 stories or less)	ACT	19	High-rise (over 20 stories)	HRB
6	Motel	M	20	Institutional bldg. (hospital, govt. or university)	IB
7	Masonry apt. or motel	MAM	21	Metal building system	MBS
8	Small retail bldg. (fast food)	SRB	22	Service station canopy	SSC
9	Small professional (doctor office, branch bank)	SPB	23	Warehouse (tilt-up walls or heavy timber)	WHB
10	Strip mall	SM	24	Transmission line tower	TLT
11	Large shopping mall	LSM	25	Free-standing tower	FST
12	Large, isolated ("big box") retail bldg.	LIRB	26	Free standing pole (light, flag, luminary)	FSP
13	Automobile showroom	ASR	27	Tree - hardwood	TH
14	Automotive service building	ASB	28	Tree - softwood	TS

Source: (NOAA, 2007)

Since this EF-Scale went into effect recently, previous occurrences and losses associated with reported tornado events, as identified below, are based on the former Fujita Scale.

Previous Occurrences and Losses

Severe storms are frequent events for SC. Data provided by FEMA on Presidential Declared Disasters identifies that no Presidential or Emergency Declarations specifically associated with severe storm events, excluding hurricanes or nor'easters, were reported for the SC. Based on all sources researched, many severe storm events, excluding severe storm hazards associated with hurricane or Nor'easter events, have impacted SC, and are identified in Table 5-21 below.

Table 5-21. Severe Storm Events between 1950 and 2007

Event Date / Name	Location	Losses / Impacts	Source(s)
Tornado (F0) September 8, 1958	SC	NA	NOAA-NCDC, The Tornado Project
TSTM August 30, 1960	L.I.	$100 K	SHELDUS
Lightning September 8, 1969	SC	$50 K – 19 injuries	SHELDUS
Tornado (F2) September 27, 1970	Closest to Huntington	$50 to $500 K in damages	City-data.com

Event Date / Name	Location	Losses / Impacts	Source(s)
Tornado (F1) September 18, 1973	Closest to Babylon	NA	NOAA-NCDC, City-data.com, The Tornado Project
TSTM December 2, 1974	Multi-County	$166 K	SHELDUS
Tornado (F1) August 10, 1979	SC	NA	NOAA-NCDC, The Tornado Project
Tornado (F1) August 5, 1981	SC	Approx. $250 K	NOAA-NCDC, The Tornado Project
Tornado (F0) August 25, 1982	SC	NA	NOAA-NCDC, The Tornado Project
Tornado (F1) August 30, 1985	SC	NA	NOAA-NCDC, The Tornado Project
Tornado (F2) / Hail July 10, 1989	Closest to Riverhead and Brookhaven	$50 to $500 M in damages, 1 injury	NOAA-NCDC, The Tornado Project, City-data.com
Tornado (F1) August 19, 1991 (2 tornados)	SC	NA	NOAA-NCDC, The Tornado Project
Lightning August 13, 1993	Commack	1 injury	NOAA-NCDC
Tornado (F0) July 23, 1995	N. Babylon, SC	$ 500 K in damages	SHELDUS, NOAA-NCDC, The Tornado Project
TSTM November 11, 1995	Cold Spring Harbor	1 fatality	NOAA-NCDC
TSTM/Winds/Hail July 18, 1997	Babylon, Deer Park	5 injuries	SHELDUS, NOAA-NCDC
Tornado (F0) June 26, 1997	Fire Island	NA	NOAA-NCDC
Lightning February 12, 1998	Ridge (Brookhaven), Southold - SC	$100 K in damages	NOAA-NCDC
Lightning February 18, 1998	Greenport, East Hampton	NA	NOAA-NCDC
Lightning June 2, 1998	East Hampton (Setauket)	4 injuries	NOAA-NCDC
Tornado (1-F0 and 2-F1)/Hail June 30, 1998 (3 events)	Selden (F0), Lake Ronkonkoma (F1), Mt Sinai (F1)	NA	NOAA-NCDC
TSTM / Hail September 7, 1998	West Babylon, Copiague	1 fatality, 2 injuries	NOAA-NCDC
Tornado (F2) August 8, 1999	Closest to Southold and Southampton (From Mattituck to New Suffolk)	$1 M in damages	NOAA-NCDC
TSTM March 11, 2000	Southampton	4 injuries	NOAA-NCDC
TSTM / Hail June 2, 2000	Stony Brook	1 injury	NOAA-NCDC
Tornado (F1) September 15, 2000	Southold	NA	NOA-NCDC
Lightning May 25, 2001	Riverhead	NA	NOAA-NCDC
Tornado (F0) / Hail July 1, 2001 (2 events)	Hampton Bays, Shinnecock Hills	NA	NOAA-NCDC

Event Date / Name	Location	Losses / Impacts	Source(s)
Lightning May 21, 2002	Port Jefferson	1 injury	NOAA-NCDC
Windstorm April 1-3, 2005	Babylon	NA	http://www.hurricanes-blizzards-noreasters.com
Lightning July 5, 2006	Bellport	1 injury	NOAA-NCDC
Tornado August 25, 2006	Amityville	minor damage - $ unknown	NOAA-NCDC, NWS, John Borris, www.Hurricanes-Blizzards-noreasters.com
Windstorm October 28, 2006	Babylon	NA	http://www.hurricanes-blizzards-noreasters.com

Note: The intensity of tornado events to affect SC is measured by the Fujita Scale, which was decommissioned on February 2007. NOAA/NCDC storm query indicated that SC has experienced 164 severe storm events between January 1, 1950 and October 31, 2006 (including TSTM, Hail, Wind/Lightning, and Tornado events). However, not all of these events were identified in this table due to their minor impact upon the county and/or participating townships/villages of this HMP.

DR	Federal Disaster Declaration
EM	Federal Emergency Declaration
F	Fujita Scale (F0 – F5)
FEMA	Federal Emergency Management Agency
FSA	Farm Service Agency
HMP	Hazard Mitigation Plan
K	Thousand ($)
LI	Long Island
M	Million ($)
NA	Not Available
NOAA-NCDC	National Oceanic Atmospheric Administration – National Climate Data Center
NRCC	Northeast Regional Climate Center
NWS	National Weather Service
NYS	New York State
SC	Suffolk County
SHELDUS	Spatial Hazard Events and Losses Database for the United States
TSTM	Thunderstorm
USDA	U.S. Department of Agriculture

Severe storm events to impact SC, excluding those associated with flooding, hurricanes, tropical storms and/or nor'easters, include, but are not limited to, the following:

September 27, 1970 (Tornado): According to City-data.com, a source that compiles data from multiple government and commercial sources, a Category 2 tornado with maximum wind speeds of 113 to 157 mph occurred on this date. The tornado was located approximately 13.7 miles from the Huntington City Center and caused between $50,000 to $500,000 in damages.

September 18, 1973 (Tornado): According to City-data.com, a source that compiles data from multiple government and commercial sources, a Category 2 tornado with maximum wind speeds of 113 to 157 mph occurred on this date. The tornado occurred closest to the Babylon area approximately 8.5 miles from it's city center.

July 10, 1989 (Tornado): According to City-data.com, a source that compiles data from multiple government and commercial sources, a Category 4 tornado (on the Saffir-Simpson Scale) with maximum wind speeds of 207 to 260 mph occurred on this date. This tornado reportedly injured 40 people and caused between $50 and $500 million in damages. This tornado occurred closest to the Riverhead and Brookhaven area approximately 32.4 to 37.6 miles from their city centers. NOAA-NCDC indicated that this F2 tornado resulted in 1 injury. No additional details were provided regarding this event.

July 23, 1995 (Tornado): A tornado touched down in South Farmingdale, NY (eastern Nassau County) and North Babylon, NY (western SC). The twister touched down in three separate locations: the first two touch-downs in South Farmingdale cut a path 1/4 mile in length and 300 to 400 feet in width, while the third touched-down in North Babylon (100 yards in length and 100 feet in width. The majority of damage was to trees, which fell on houses, cars, pools, and fences. Many sheds were lifted and smashed to the ground and there were reports of some houses receiving roof damage. One house had a porch ripped away. No injuries were reported (NRCC, 1995). According to NOAA-NCDC, this F0 tornado caused $500,000 in damages in N. Babylon, due to downed trees and power lines and damaged homes and cars.

July 18, 1997 (Thunderstorm): According to NOAA-NCDC, two "waves" of severe thunderstorms moved southeast across the area on this date. The first line of thunderstorms moved across Nassau and Western Suffolk Counties during the early afternoon. The second line of thunderstorms moved over the area during the evening. For the day, these thunderstorms caused two deaths and 24 injuries. Both lines of severe thunderstorms produced high winds. In addition, the first line produced large hail. Selected wind gusts from Western SC that were documented with the passage of the first line include: 60 mph at both Babylon and Farmingdale Airport; and 58 mph at Bohemia. Significant structural damage (several roofs were blown off businesses) resulted in five injuries in Deer Park. A NWS Meteorologist investigated this damage and concluded that it was caused by a microburst. At least 3 roofs were blown off (the K-Lombardi Repair Shop and 2 businesses on Price Parkway). In addition to the 1 inch diameter hail observed at Babylon, 3/4-inch diameter hail occurred at Deer Park. Monetary losses were not provided.

February 12, 1998 (Lightning): According to NOAA-NCDC, a lighting event resulted in $100,000 in structural damages to a house in Ridge (Brookhaven) and Southold. Lightning caused significant structural damage to a house at 59 Giant Oak Road in Ridge. According to the Ridge Fire Department, lightning struck the house. Two-by-fours in the roof exploded and struck and punctured the house next to the one that caught fire. The second floor of this two-story Cape Cod was totally destroyed. Lightning also struck a house on Bay Haven Road in Southold. It gouged a hole at the base of a tree and carved a furrow across the lawn. Lightning struck the sprinkler system, hit the septic tank, ran along the pipes, blew the cap from the waste pipe into the basement stairs (cracking them), and struck the clothes dryer which ignited a basement fire.

February 18, 1998 (Lightning): According to NOAA-NCDC, as a warm front between two low pressure systems moved north, it produced heavy showers and thunderstorms. Lightning struck a house at 1445 Bay Shore Road in Greenport and set it ablaze. The house was totally destroyed. Two other houses in the Greenport area were also struck: minimal damage occurred to one house and no apparent damage occurred to the other house. Lightning also struck a propane tank next to a house in East Hampton. It ignited a fire that totally destroyed this house. Monetary losses were not documented in the materials available for review.

June 2, 1998 (Lightning): According to NOAA-NCDC, as thunderstorms moved east across SC, they produced frequent lightning. Lightning struck a barn in East Hampton (at the Oakdale Farms property on Three Mile Harbor Road) and sent electricity through four volunteer firemen. All four men required hospital treatment. Lightning also struck a brick chimney in a Setauket home, causing bricks to fall into the backyard as well as into the structure itself. Monetary losses were not documented in the materials available for review.

September 7, 1998 (Thunderstorm): According to NOAA-NCDC, an intense line of severe thunderstorms oriented from north to south developed during Labor Day afternoon ahead of a strong approaching cold front. As the storms moved east at 40 to 50 mph, they produced high winds, large hail, and an isolated tornado. Wind gusts from 60 to 80 mph downed many trees and power lines throughout the area. In SC, high winds overturned many boats in the Great South Bay, downed large trees in West Babylon and Rocky Point, and downed large tree limbs in Wading River. One person died when a thunderstorm wind gust capsized a 19-foot sail boat in Great South Bay near Copiague. A Centerport woman, 36, and her daughter, 3, were injured when a tree fell on them in the parking lot of the Ground Round Restaurant and CVS on Fort Salonga Road. The following peak wind gusts were reported: 72 mph in Babylon and 65 mph in Fire Island. Monetary losses were not documented in the materials available for review.

August 8, 1999 (Tornado): According to NOAA-NCDC and City-Data.com, an F2 tornado caused $1 million in damages and 1 injury in Mattituck to New Suffolk. A cluster of severe thunderstorms formed north of an approaching strong warm front and moved east-southeast, just north of the front. A severe thunderstorm produced a tornado along the south shore of the North Fork of SC on Long Island. The tornado touched down and lifted several times along a 4 mile path as it moved east-southeast from just southeast of Mattituck Air Base, across Marratooka Pt., Kimogener Pt. (of New Suffolk), Cutchogue Harbor, Central Nassau Pt., then lifted as it crossed Hog Neck Bay. NSW data indicate that the tornado touched down first in southern sections of Mattituck. This was in the backyard area bounded to the west by Marratooka Road, to the north by Center Street, and to the south by Park Ave. Most damage at this location was to trees, where many tops were twisted off and several snapped off at 5 to 15 feet above the ground. This was estimated as F1 damage. The tornado "bounced" and continued east to the dirt road extension of Park Avenue, where it lifted the roof off a cottage. The roof of the building detached from the house and was carried about 115 feet to the northeast. The tornado continued east for about 1/2 mile, then touched down again at 10 Kimogenor Point. It ripped off the porch and part of the main roof of the house at this address. It apparently developed a few separate vortices at this location. One twisted a 100 year old metal windmill over high tension power lines and did some significant damage to large trees. Another vortex slammed into the front porch at 2 Kimogenor Point and ripped off the porch and a large section of the roof of the house. The lone inhabitant said he saw a "wall of water" heading toward his house and instinctively dove into the stone fireplace to protect himself as the storm hit. Winds were estimated over 100 mph over this part of the tornado's path. The tornado continued east along Jackson Avenue, impacting many mature trees in the area. The most significant damage occurred in the vicinity of Jackson Avenue and Fifth Street, where winds were estimated from 110 to 120 mph, based on the to the devastation of many large trees. This was the area where F2 damage was observed. This was also the widest path width, estimated at 300 yards. The tornado continued east along Jackson Avenue, creating F1 damage then went over Cutchogue Harbor. Eyewitnesses from Nassau Point (Little Hog Neck) said they saw the tornado over the water just east of New Suffolk. They saw several suction vortices rotating around the main funnel. The tornado moved across Nassau Point, in the vicinity of Wunnaweta Pond, where it twisted and sheared off many trees that fell on and damaged houses. It bounced again and hit close to the ground near #6225 and #6325 Nassau Point Road. Many trees fell onto, and damaged, homes. These backyards were on top of a cliff overlooking Hogs Neck Bay. The tornado lifted before hitting these homes. This was the last indication of tornado-related damage. The latest cost estimates of damage from the Southold Supervisor's Office are in excess of $1 million dollars. One injury occurred as a person was struck by flying debris.

July 5, 2006 (Lightning): According to NOAA-NCDC, this event resulted in a 34-year-old man being struck by lightning while erecting a fence at Frank P. Long Intermediate School. No additional information was provided.

August 25, 2006 (Tornado): According to Mr. Jack Boris of WCBSTV.com, an F0 Tornado with winds of 60 to 70 mph occurred in SC on this date. There were reports of damage to trees and cars and Con Edison reported 14,000 customers without power (Boris, 2006).

NOAA-NCDC indicated that a severe thunderstorm produced a weak F0 tornado as it moved across extreme southeast Nassau County and extreme southwest SC on this date. The tornado's path length was only about ¼ mile long and it's maximum path width was around 150 yards. There was significant tree damage along it's path. Rotation was evident based on impacts to the tops of many trees. The most damage occurred in East Massapequa between Merrick Road and Route 27A, Old Sunrise Highway. It was concentrated around Clocks Boulevard. southeast across Melrose Avenue and County Line Road, then across Amityville's Old Fields and Homestead Avenues. The tornado lifted into the parent cloud before reaching South Ketcham Avenue. This severe thunderstorm produced damaging winds, large hail, and torrential rain along it's path. Large tree branches were downed in Wantagh. Quarter size hail was reported in Farmingdale. Flash flooding also occurred along it's path. Monetary losses were not documented in the materials available for review.

October 28, 2006 (Windstorm): As identified by (Long Island Hurricane History, 2007) a windstorm impacted sections of Babylon, NY (Figure 5-42). Impacts and monetary losses were not documented in the materials available for review.

Figure 5-42. October 28, 2006 Windstorm in Babylon, NY

Source: (Long Island Hurricane History, 2007)

Probability of Future Events

In Section 5.3, the identified hazards of concern for SC were ranked. The NYS Hazard Mitigation Plan conducts a similar ranking process for hazards that affect the State. The probability of occurrence, or likelihood of the event, is one parameter used for ranking hazards. Based on historical records and input from the Planning Committee, the probability of occurrence for severe storms in SC is considered frequent [hazard event that occurs more frequently than once in 10 years ($>10^{-1}$/yr), as presented in Table 5-4]; however, impacts only related to severe storms, excluding those associated with hurricanes, tropical storms and flooding, and Nor'easters are expected to be minimal. It is estimated that SC and all of its jurisdictions, will continue to experience severe storms annually that may induce secondary hazards such as utility failure and transportation accidents.

VULNERABILITY ASSESSMENT

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For severe storms, the entire County has been identified as the hazard area. Therefore, all assets in SC (population, structures, critical facilities and lifelines), as described in the County Profile section, are vulnerable to a severe storm. The following text evaluates and estimates the potential impact of severe storms on SC including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact, including: (1) impact on life, safety and health of county residents, (2) general building stock, (3) critical facilities, and (4) economy
- Further data collections that will assist understanding of this hazard over time
- Overall vulnerability conclusion

Overview of Vulnerability

As defined for this HMP, severe storms include hail, lightning, thunderstorms, tornadoes and windstorms. The high winds and air speeds associated with these storm events often result in power outages, disruptions to transportation corridors and equipment, loss of workplace access, significant property damage, injuries and loss of life, and the need to shelter and care for individuals impacted by the events. A large amount of damage can be inflicted by trees, branches, and other objects that fall onto power lines, buildings, roads, vehicles, and, in some cases, people. The risk assessment for severe storm evaluates available data for a range of storms included in this hazard category.

The entire inventory of the County is at risk of being damaged or lost due to impacts of severe storms. Certain areas, infrastructure, and types of building are at greater risk than others due to proximity to falling hazards and their type of construction.

Potential losses associated with high wind events were calculated for SC using HAZUS-MH for two probabilistic wind/hurricane events, the 100-year and 500-year MRP events. The impacts on population, existing structures, critical facilities and the economy are presented in the hurricane profile.

Data and Methodology

FEMA's How-To #2 (FEMA #386-2) states there are no standard loss estimation models and tables available to estimate losses from tornado events. FEMA does not describe methods to estimate losses from lightning, hail, or thunderstorm events. As advised by FEMA for estimating losses for tornadoes, national weather databases and local resources were used to collect and analyze severe storm impacts on the County. As discussed above, HAZUS-MH was used to calculate potential losses associated with high wind events (see the hurricane hazard profile).

Impact on Life, Health and Safety

The entire County is identified as the hazard area vulnerable to severe storms. According to the 2000 U.S. Census, SC had a population of 1,419,369 people. This number excludes the incoming commuter population and the seasonal population that increases in the summer months, when these hazard events typically occur. Per the planning department, it is estimated that the eastern SC population (Towns of Riverhead, Southold, Shelter Island, Southampton, and East Hampton) more than doubles during the summer. Daytime in-commuting and seasonal changes in population (the summer) affect the total population vulnerable to this hazard and the number of residents that may evacuate, be displaced or require temporary to long-term sheltering. SC's current evacuation plans take temporal changes in population into account.

Vulnerable populations, including the elderly and low income populations, are considered most susceptible to the severe storm hazard. Socially vulnerable populations are most susceptible, based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Low income residents may not have adequate housing able to withstand high winds associated with tornadoes (i.e., mobile homes). According to FEMA, the safest place for people during a tornado is in a safe-room or storm shelter designed to specific performance criteria. The 2000 U.S. Census indicates that there are 5,374 mobile homes in SC. Based on past occurrences of severe storm events in SC, injuries and loss of life resulted from fallen trees, flying debris and electrocution from a lightning strike.

SC recognizes it has a large special needs population and is committed to providing the best possible assistance to these citizens when an emergency is imminent. The SC Comprehensive Emergency Management Plan outlines the SC Joint Emergency Evacuation Program (JEEP). JEEP provides emergency evacuation assistance (shelter and transportation) to citizens that are particularly at risk during emergency situations.

Impact on General Building Stock

The entire inventory in the County is vulnerable to severe storms. The data in HAZUS-MH estimates that there are 461,871 structures in SC, with a total building replacement value (structure and content) of greater than $210 billion. Approximately 99% of the buildings and 84% of the building stock structural value are associated with residential housing. Because of differences in building construction, residential structures are generally more susceptible to wind damage than commercial and industrial structures. Please refer to Section 4 (County Profile) which presents building stock statistics by occupancy class for the County.

There are certain limitations to using HAZUS-MH. This plan utilized HAZUS-MH <u>default data</u> to perform a HAZUS Level 1 analysis. HAZUS-MH is only intended to provide an estimation of building replacement value, using estimates for typical buildings in a given census block. It is only as current and/or accurate as the US Census 2000 data, and it does not reflect specific local building conditions, such as a higher percentage of luxury structures, higher local costs to procure and transport building materials through New York City, and the recent dramatic worldwide increases in the cost of building construction materials and products and/or services dependent upon the price of petroleum. Plan participants have indicated the values presented herein significantly underestimate the actual Replacement Cost Values (RCV) in Suffolk County.

Current modeling tools are not available to estimate specific losses for this hazard, with the exception of windstorms. Please refer to the hurricane profile for a detailed look at potential estimated building values (structure and content) damaged by 100-year and 500-year MRP wind events (hurricane).

According to FEMA's How-To #2 (FEMA #386-2), the most important factor in assessing vulnerability to tornadoes is to examine how likely structures will fail when exposed to winds that exceed their design or to flying debris that may penetrate the structure. "Structural damages from tornadoes are a function of the building's relative location to the tornado vortex, which cannot be predicted or mapped. In general, building damages can range from cosmetic to complete structural failure, depending upon the wind speed and location of the building with respect to the tornado path. Only a qualified architect or structural engineer can do more than the most rudimentary analysis of a building's capacity to resist the effects of a tornado." Page 4-27 of the guidance continues to state there are no building structure and content "…standard loss estimation models and tables for tornadoes…" The guidance advises to estimate structure and content vulnerability and content losses based on past occurrences of tornadoes. Available historic loss information indicates damages ranging from $50,000 to $500 Million per F0 to F2 tornado event.

A similar approach using historic structure and content losses to estimate damages to general building stock due to hail, lightning and thunderstorm events was used. In the past, buildings struck by lightning in SC have experienced minimal structural impact to total destruction (due to fire). For thunderstorms, the only documented historic loss was three roofs blown off homes caused by a microburst. Monetary losses documenting structural damage as a result of hail, lightning and thunderstorm events was not found in available resources.

A specific area that may be vulnerable to the severe storm hazard is the flood plain, including low-lying coastal zones. Thunderstorms are often accompanied by heavy rain causing flooding. Generally, losses resulting from flooding associated with thunderstorms should be less than that associated with a 100-year or 500-year flood. Infrastructure at risk due to flooding is presented in the flood hazard profile.

Impact on Critical Facilities

All critical facilities are considered vulnerable to the severe storm hazard. HAZUS-MH estimates the replacement value for critical facilities and infrastructure in SC (see Section 4 – County Profile). Because power interruption can occur, backup power is recommended.

Severe storm events may require short-term sheltering of residents. FEMA recommends that communities assess the number, location, capacity and strength of shelters to ensure they can adequately house displaced residents and withstand design wind spend, especially for tornado events). Currently, SC has 127 designated shelters. The default replacement value for these shelters is $590,000 each with masonry construction. Table 4-15 lists the designated shelters in SC.

Impact on Economy

The high winds associated with severe storm events often cause power outages, disruptions to transportation corridors and equipment, and loss of workplace access, all of which impact the local economy. Additionally, damage can also be inflicted by trees, branches, and other objects that fall onto power lines, buildings, roads, and vehicles. Sufficient information was not available to perform a detailed assessment of estimated losses to the economy. It is estimated that the impact to the economy, as a result of severe storm event, would be considered "low" in accordance with the risk ranking shown in Table 5-5.

Additional Data and Next Steps

As defined for this plan, the severe storm event cannot currently be modeled in HAZUS-MH (tornado, thunderstorm, etc.). However, additional detailed loss data from past and future events will assist in assessing potential future losses. Based on these values and a sufficient number of data points, future losses could be modeled in some fashing. Alternately, percent of damage estimates could be made and multiplied by the inventory value to estimate potential losses. This methodology is based on FEMA's How To Series (FEMA 386-2), Understanding Your Risks, Identifying and Estimating Losses (FEMA 2001) and FEMA's Using HAZUS-MH for Risk Assessment (FEMA 433) (FEMA 2004). SC will continue to compile data and track modeling tools to identify means to refine current loss estimates in the future. In addition, it will continue mitigation planning to be prepared for such events and minimize their impact on humans and structures in the future.

Overall Vulnerability Assessment

Severe storms are common in the study area, often causing impacts and losses to the County's structures, facilities, utilities, and population. Existing and future mitigation efforts should continue to be developed and employed that will enable the study area to be prepared for these events when they occur. The overall hazard ranking determined by the Planning Committee for this hazard is high (see Tables 5-6 and 5-7).